

Claims

1. A conditioning apparatus for a scanning probe or similar device having a nanometer-scale tip embedded in a material or a nanometer-scale opening
5 in said material, respectively, *comprising*
- a first medium, being a solid medium, reacting with said material,
 - means for positioning said scanning probe essentially along its longitudinal axis such that its tip or opening can be brought in contact with said solid medium, and
 - 10 - means for automatically governing said conditioning and for repositioning said probe when predetermined conditions are met.
2. The conditioning apparatus according to claim 1, *further comprising*
- a second medium reacting with the material, and
 - 15 - means for moving the probe between the solid medium and said second medium.
3. The conditioning apparatus according to claim 2, *wherein*
- the second medium is a liquid medium, preferably an electrolyte contained
20 in a separate housing means.
4. The conditioning apparatus according to claim 2, *wherein*
- one of the media is a reactive material-depositing medium,
 - another one of the media is a reactive material-removing medium, and
 - 25 - the positioning means enables placing the probe in contact with each of said media.
5. The conditioning apparatus according to claim 4, *wherein*
- the reactive material-depositing medium is a liquid medium and
 - 30 - the reactive material-removing medium is a solid medium, both being preferably electrolytes.

6. The conditioning apparatus according to claim 4, *wherein*
- at least one electrolytic cell is formed with the scanning probe as a movable electrode, an electrolyte, and a fixed electrode,
- 5 - material is deposited or removed, resp., from said scanning probe by driving an electric current through said electrolytic cell,
- said current being stabilized, preferably at a predetermined value, by the means for governing the conditioning.
- 10 7. The conditioning apparatus according to claim 1, *wherein*
- the positioning means further enables translating, shifting, rotating, tilting and/or otherwise moving the scanning probe relative to the reactive medium, preferably in an oscillatory mode and/or during the conditioning process, to obtain a predetermined shape or surface of its tip or opening.
- 15 8. The conditioning apparatus according to claim 1, *wherein*
- the governing means is adapted to the conditioning of an aperture scanning probe having a transparent medium,
 - said governing means including a radiation detector for monitoring the radiation passing through and exiting said probe, said radiation detector thus
- 20 controlling the deposition of material onto, or removal from, said transparent medium,
- 25 9. A scanning/conditioning apparatus, combining the functional parts of a scanning probe microscope and of a conditioning apparatus according to claim 1, *including*
- a first zone for imaging a sample by scanning a probe relative to said sample,
 - a second zone for conditioning said probe,
- 30 - means for positioning said probe relative to said two zones, and
- means for operating said scanning probe microscope alternatively in an imaging mode or a conditioning mode.

10. The scanning/conditioning apparatus according to claim 9, *wherein*

- the conditioning zone includes means for performing at least one solid state chemical reaction to provide the desired conditioning of the probe.

5 11. A method for conditioning, i.e. fabricating, reshaping or repairing, a scanning probe or similar device having a sharp tip embedded in a material or a small opening in said material, resp.,
comprising,

- conditioning at least one selected area, in particular the tip area, of said
10 scanning probe, preferably by chemical reaction with one or more reactive media, including at least one solid medium, by a process of removing and/or depositing and/or modifying small amounts of said material,
- controlling/monitoring said process, and
- modifying parameters of said process, in particular slowing down or stop-
15 ping said process, when preselected conditions are achieved.

12. The method according to claim 11, *wherein*

- at least one solid reactive medium is being used during the conditioning,
- progress of a chemical reaction with said solid reactive medium is moni-
20 tored by at least one parameter characteristic for said progress,
- said parameter's value is used as input to govern the conditioning by controlling the position of the probe with respect to said reactive medium.

13. The method according to claim 12, *wherein*

- the chemical reaction includes at least one electrolyte as reactive medium,
25 - electrodes are provided thus forming an electrolytic cell,
- the material is deposited and/or removed and/or modified by driving an electric current through said electrolytic cell, and
- said current is monitored to serve as input for the stabilization or modifica-
30 tion of the parameters of the process.

14. The method according to claim 11, *wherein*

- the solid reactive media is a glass, preferably in the shape of a thin platelet, and/or preferably containing or consisting of $\text{AgPO}_3\text{-AgI}$, or iodine or an alkali hydroxide.

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15. The method according to claim 11 for fabricating the aperture at the tip of an aperture scanning probe having a transparent core and an opaque coating, *comprising*

- generating the small opening in said opaque coating,
- 10 - transmitting radiation, preferably light, through said opening,
- measuring the intensity of said radiation transmitted through said opening and employing it as the characteristic parameter, and
- slowing down or stopping the coating removal process when a predetermined value of said radiation intensity is reached.

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16. The method according to claim 11 for reshaping or repairing the aperture of an aperture scanning probe having a transparent core embedded in an opaque coating material, *wherein*

- the volume or coverage of said opaque coating material is increased by
- 20 depositing additional coating material at the apex of said probe by reacting with a first reactive medium until the diameter of said aperture is reduced to a first predetermined value.

17. The method according to claim 16, *wherein*

- 25 - the aperture is opened up again to a second predetermined value by a reaction with the same or a second reactive medium.

18. The method according to claim 11, *further comprising*

- 30 - translating, shifting, rotating, tilting, and/or otherwise moving the scanning probe relative to the reactive medium, preferably in an oscillatory mode and/or during the conditioning, to obtain a predetermined shape or surface of its tip or opening.

Variable	Mean	SD	Min	Max
Age	38.5	10.2	22	65
Gender	0.5	0.5	0	1
Marital status	0.7	0.5	0	1
Education	12.5	1.5	9	16
Income	15.2	8.5	5	35
Health status	0.8	0.4	0	1
Stress level	3.2	1.5	1	5
Life satisfaction	4.5	1.2	3	6
Work satisfaction	3.8	1.0	2	5
Family satisfaction	4.2	1.1	3	5
Community satisfaction	3.5	0.9	2	4
Overall satisfaction	3.9	1.0	2	5

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